ABSTRACT

A nonpolarization-dependent method and apparatus for optical sampling of a user optical signal of a known frequency range (e.g., corresponding to 1550 nm wavelength) uses a probe signal in an unsplit form and applies a conversion {e.g., by sum frequency generation (SFG) }operation in a first stage to the probe signal and to a first polarization component of the user optical signal (e.g., 's' component) to produce a first component of an output signal. In a second stage, a second polarization component of the user optical signal (e.g., 'p' component) is rotated by 90° to align with the first polarization component and then converted by mixing with the unsplit probe signal to produce a second component of an output signal. The first and second output component signals are both added and measured using a photomultiplier tube (PMT) or an avalanche diode. If the probe signal is approximately a second harmonic of the user optical signal, then the output will be a near-third harmonic. The SFG may be performed by using a nonlinear wavelength converter such as a periodically poled lithium niobate (PPLN) crystal of predetermined dimensions. The first and second stages may be completed using different PPLNs, or, by using a single PPLN in a double pass technique. In the double pass technique, in the first stage, the 's' component of the user input signal may be subjected to SFG to produce the first near-third harmonic output signal by using an unsplit second harmonic probe signal. A ¼ waveplate in the double pass technique rotates the second polarization component of the user's input signal by 45° twice to achieve a 90° rotation. From the second stage in the double pass technique, a second near-third harmonic output signal, e.g., at 520 nm is generated, which is also directed to the PMT similar to the first stage. Higher conversion efficiencies are achieved by using both polarization components of the user input signal, and using an unsplit probe signal from a source which is approximately half the power which would otherwise be needed if the probe signal is split.